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## HIGH DENSITY INFORMATION PRESENTATION USING SPACE-CONSTRAINED DISPLAY DEVICE

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### BACKGROUND OF THE INVENTION

#### Field of the Invention

[1001] The invention relates to information presentation and, in particular, to devices, systems and methods for presenting information using a space-constrained display device.

#### Description of the Related Art

[1002] In recent years, use of mobile phones, pagers, personal digital assistants (PDAs) and other portable information devices has become pervasive. As use of such devices has increased, so too have the demands for rich information content. While the size, resolution and flexibility of displays employed by such devices have improved dramatically, space-constraints are inevitable. Unfortunately, space-constraints limit the richness of information content available to a user. Examples of these limitations can be found in the set of "web-enabled" mobile phones that have begun to enter the marketplace. Typically, such mobile phone interfaces have attempted to squeeze web-oriented presentation paradigms into the comparatively small display screens available given size, weight, power and other design constraints. The display paradigms employed have typically been based on text-based links and sparse graphics that attempt to reproduce on the phone, in dramatically scaled down form, the presentation of a typical web page. Unfortunately, the size of such display screens (often as small as 4 lines of text with 15 character width) are wholly inadequate for such displays. These interfaces have been heavily criticized for poor usability and sluggishness.

[1003] New display paradigms are needed. In particular, techniques, systems and devices are needed that will allow high-density presentation of information despite the substantial space-constraints typical of portable information devices.

### **SUMMARY OF THE INVENTION**

[1004] Accordingly, it has been discovered that a high-density information presentation may be provided on a space-constrained display device by associating individual display indications with user-definable states. For example, using a portion of a space-constrained display of a mobile phone, pager personal digital assistant or other portable device, one or more external states may be presented as a simple graphical or character indication that corresponds, in a user-defined way, to the external state or states. A wide range of potential external states is envisioned. For example, applications to monitoring weather or environmental states (e.g., chance of rain greater than 50%, local pollen count greater than a level warranting allergy medication, etc.), system or information status (e.g., up status of a server, presence of new mail from a particular person, etc.) or news or sports information (e.g., win/loss of a particular team, stock price reaching trigger value, etc.) are all envisioned. In general, the association of a particular state with a display indication is user definable. Indeed, in some realizations, a particular state and even a mechanism for monitoring or obtaining the state may be user defined. In others, sets of states and/or monitoring mechanisms may be predetermined and particular ones may be user selected from the predetermined set.

[1005] Typically, external states are monitored by an information service or server and communicated for presentation on the space-constrained display via a telecommunications network. Any of a variety of communications technologies and data encodings is suitable. For example, in realizations for presentation on a space-constrained display of a mobile phone or PDA, wireless voice or data networks may be employed and protocols and encodings such as wireless application protocol (WAP), wireless markup language (WML), iMode and cHTML may be employed.

[1006] In one embodiment in accordance with the present invention, a method of presenting information on a space-constrained display of a portable device includes associating a first indication on the display with a user-defined external state,

establishing a user-defined operation for monitoring the user-defined external state, and updating the first indication on the display in accordance with the monitored user-defined external state in response to an information encoding thereof received via a telecommunications network. In some embodiments, the user-defined operation is performed using a networked computational service remote from the portable device and the information encoding is supplied in correspondence therewith. In some variations, association of the first indication with the user-defined external state is performed without use of the portable device, while in others such associations are made via the portable device. In various realizations, the portable device includes a phone, a personal digital assistant, a pager, a palm- or handheld-computer, a digital media player, a communications-enabled portable device, a WAP- or iMode-enabled portable device, or any combination thereof. In various realizations, the telecommunications network transmission and routing facilities include a wireless voice network, a wireless data network, a packet-switched data network, an internet or intranet, a local- or wide-area network, a public switched telecommunications network (PSTN), or any combination thereof.

[1007] In another embodiment of the present invention, a portable device includes a space-constrained display and a communications interface to a telecommunications network. The space-constrained display includes a two-dimensional array of display elements suitable for simultaneously presenting plural visual indications displaced throughout at least a portion of the display. The communications interface is coupled to the space-constrained display and allows the portable device to receive information encoding one or more external states and to update respective one or more of the visual indications based on respective user-defined associations with the external states. In some variations, the external states are user selected and include weather status, environmental status, system status, information status, news, sports or financial status, etc. In various realizations, the portable device is embodied as a phone, a personal digital assistant, a pager, a palm- or handheld-computer, a digital media player, a communications-enabled portable device, a WAP- or iMode-enabled portable device, or any combination thereof.

[1008] In still another embodiment of the present invention, a computer program product is encoded in at least one computer readable medium and includes first and

second functional sequences. The first functional sequence is executable to establish an association between plural indications on a display of a portable device and respective user-defined external states. The second functional sequence is executable to supply, via a telecommunications network, an information encoding for update of the indications on the display in accordance with the user-defined external states. In some variations, the computer program product further includes a third functional sequence executable to monitor of the user-defined external states.

[1009] In still yet another embodiment of the present invention, an apparatus includes means for presenting a visual indication on a display device, means for associating, based on a user selection, the visual indication with a state external to the apparatus, and means for receiving an information encoding corresponding to the external state and for updating the visual indication based thereon.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

[1010] The present invention may be better understood, and its numerous objects, features, and advantages made apparent to those skilled in the art by referencing the accompanying drawings.

[1011] **FIG. 1** illustrates a system in which some realizations of the present invention are exploited.

[1012] **FIG. 2** illustrates a mock-up of a space-constrained display and one display indication configuration in accordance with the present invention.

[1013] **FIG. 3** depicts data and control flows for cooperating components of a realization in accordance with the present invention, which provides a user with a network-resident service for defining monitored states and associated display indications for presentation on a space constrained display.

[1014] The use of the same reference symbols in different drawings indicates similar or identical items.

## **DESCRIPTION OF THE PREFERRED EMBODIMENT(S)**

[1015] **FIG. 1** illustrates a system including exemplary portions of a telecommunications network that facilitate monitoring and dissemination of data to support a high-density presentation of information on a space-constrained display. In the illustration of **FIG. 1**, portable phone **101** receives (via telecommunications facilities **102**) data that encodes information for presentation on display **111** thereof. The data encodings correspond to states monitored by an information service (e.g., networked server **103**) based on user-defined selections, criteria, thresholds, query definitions, etc.

[1016] In general, the monitored states are defined in terms of data that may be stored local to the information service (e.g., represented in local storage **105**) or that are available from other information services (e.g., networked server **104**) accessible to the monitoring information service. Underlying data may concern weather, sports, news, financial, environmental, personal or other information. In the illustration of **FIG. 1**, networked server **103** monitors external states (i.e., states represented external to portable phone **101**) in accordance with user selections (e.g., of a particular stock ticker symbol) and/or criteria or thresholds (e.g., less than a particular price).

[1017] Depending on the particular implementation, predetermined sets of external states may be provided for selection by a user. Alternatively, user-defined queries or monitoring scripts may be employed to allow greater flexibility. As described more completely below, user-defined associations of particular external states with particular display indications are also provided. In some implementations, access to (and/or definition or selection of) the external states to be monitored, to display associations and to other configuration information is provided using a browser or other form of user interface. Accordingly, some realizations of networked server **103** include a web server and support HTML interactions such as with a browser hosted at client computer **108**. In such a realization, a user may use client computer **108** to access an account preferences page hosted by networked server **103** at thereby configure display options for display **111** of portable phone **101**. To facilitate use, such a preferences page may mimic, or otherwise allow the user to preview, the configured display options. In some implementations, a user interface to such

configuration information may be provided using facilities provided by the portable phone 101, itself.

[1018] Based on a user-defined set of external states and based on the desired display indications, networked server 103 supplies data encodings appropriate for the particular requirements and/or capabilities of telecommunications facilities 102 and portable phone 101. In general, suitable data encodings will vary from implementation to implementation. However, in some implementations, suitable protocols and encodings are defined in accordance with agreed or *de facto* industry standards such as the wireless application protocol (WAP), wireless markup language (WML), or Bluetooth wireless technology or in accordance with vendor-specific mobile internet access systems such as imode (available in Japan from NTT DoCoMo) and cHTML. In general, for implementations in accordance with the present invention, suitable protocols and encodings include any existing or hereafter developed protocols and encodings that allow user-defined indications to be conveyed to a space constrained display based on a user-defined set of external states monitored by an information service. Persons of ordinary skill in the art will appreciate suitable exploitations of such protocols and encodings based on the description herein.

[1019] FIG. 2 illustrates a simple display configuration 211 for a space-constrained display such as display 111 of portable phone 101 (see FIG. 1). The illustrated display configuration allows a user to monitor (and in some realizations, access) a comparatively large amount of information in a constrained display area. For simplicity of illustration, individual display indications 202 are shown as rectangular blocks of pixels that present at least two states (e.g., all on and all off). In the illustration of FIG. 2, the display indications are themselves arrayed in rectangular grid over at least a portion of display 211. Nonetheless, other display indications and arrangements thereof are also suitable. For example, display indications may be larger or smaller in size and may be defined to present more complex patterns, images, icons or symbols. Combinations of such patterns, images, icons or symbols may be employed. In addition, a display indication may exhibit a larger number of states that may be presented as gradations of shade or color, or through use of varying patterns, images, icons or symbols rendered at approximately the same apparent position on display 211. Distributions of display indications over a display may

mimic the rectangular geometry illustrated. Alternatively, other geometries, patterns or tessellations may be employed.

[1020] In view of the above, and without limitation, the description that follows focuses on the illustrated rectangular grid of two-state rectangular-shaped display indications. Nonetheless, based on the description herein, persons of ordinary skill in the art will appreciate suitable variations for other display configurations in which individual display indications are associable with user-defined (i.e., defined or selected) states external to the device incorporating the display.

[1021] Focusing then on the illustration of FIG. 2, display indications 202 are arranged in a rectangular grid and each correspond to a reasonably current sample of an external state. The grid presents a user-defined arrangement of the display indications, which visually conveys a variety of external states defined or selected by the user for monitoring. Some examples of external states that might be monitored include:

1. *System of Information Status*. For example, do I have new email from person X? What is the status (armed, disarmed, etc.) of my home burglar alarm system? Have any of the servers for which I am responsible down?
2. *Weather or Environmental Status*: For example, if the local pollen count greater than a level that warrants my use of an allergy medication? Has it been more than N days since the last precipitation at a local weather observation station? Do a majority of the local weather forecasts predict at least a 50% chance of rain today?
3. *News, Financial or Sports Status*: For example, is my favorite sports team playing today? Have any of my stocks on a watch list reached my trigger price?

[1022] The set of possible associations between individual display indications 202 and external states is virtually limitless. Depending on the particular implementation, users may be provided a generalized capability to define arbitrary external states and techniques for ascertaining these external states. For example, a generalized scripting facility could be provided. Alternatively, the user-defined set of external states may

be selected from amongst predetermined states with corresponding predetermined monitoring techniques. Some implementations may provide both facilities for establishing the user-defined set.

[1023] In any case, user-defined external states are associated with particular display indications. While each display indication may be individually associative with a monitored external state, users may wish to (and some implementations may provide facilities to) group like display indication. In this way, display indications corresponding to related external states can be grouped together to convey categorical information, e.g., by grouping in adjacent display indications so that the user can instantly recognize whether any of his contacts have posted information. For instance, in the illustration of **FIG. 2**, the individual display indications grouped as display indication group **221** may individually correspond to the current up-status of 15 servers for which the portable device user is responsible. Given such a user-defined association, the illustrated display state might indicate that 11 of the 15 servers are currently “up.” Similarly, the individual display indications grouped as display indication group **222** may correspond to > 20%, > 40%, > 60% and > 80% chance of rain, respectively. In general, both individual associations and groupings may be user-defined.

[1024] In addition to the rectangular grid, a text display line **203** is also provided in the illustrated display configuration. This additional display indication may be employed to augment information conveyed by the previously described grid. For example, on a display device that includes a navigation or selection capability, a user could navigate the grid using directional buttons. In the case of a portable phone or pager, navigation may be provided by a pair of “forward” and “back” or by mapping other buttons to navigation functions (e.g., 2=up, 8=down, 4=left, 6=right). Some devices, e.g., PDAs may employ a stylus. In general, suitable navigation and selection facilities will be device dependent. Whatever the facility, when a particular of the display indications **202** is selected from the grid, text display line **203** may be employed to present additional detail. For example, a fixed description of the monitored external state (e.g., “Chance of Rain”) or user-defined text (e.g., “Take your Benadryl now”) may be presented. In some implementations, the descriptions presented on text display line **203** may correspond to the state presented by the

associated display indication (e.g., “Gatekeeper: Status Normal” or “Gatekeeper: Intrusion Detected”). In others, the description may simply identify the external state represented by the associated display indication (e.g., “Server 12 Status”).

[1025] In some implementations, event notification facilities (e.g., audible, vibrating alert, etc.) may be provided. For example, as monitored events occur (e.g., as the portable device receives encodings that indicate a change of state for a monitored external state), the device may notify the user immediately (for special high-priority events) or, more commonly, accumulate the events. When the user checks the device, the number of events accumulated since last review may be presented, e.g., using the text display line 203, together with the details of the most recent event. In some implementations, the user may navigate through the events using an appropriate navigation/selection facility. For example, up and down navigation buttons on a portable phone may be employed to move from one display indication to the next (or previous) display indication corresponding to an accumulated event. Typically, details presented using text display line 203 are updated in correspondence with such navigation. Optionally, the data grid may further identify (e.g., blink or highlight) the display indication(s) corresponding to each such event. Such identifying behavior may help the user to build meaningful associations between events and their corresponding display indication(s).

[1026] **FIG. 3** depicts data and control flows for cooperating components of an illustrative implementation in which a network-resident service allows user-definition of monitored states and associated display indications for presentation on a space constrained display. In general, a user interacts with the network-resident service by defining and/or selecting (311) particular external states for monitoring and by associating (312) particular display indications. As described above, depending on the particular implementation, users may be provided with a generalized capability to define arbitrary external states and techniques for ascertaining those external states, whether represented locally or on a remote information service. For example, a generalized scripting facility or database query facility may be provided. Alternatively, the user-defined set of external states may be selected from amongst predetermined sets of states with corresponding predetermined monitoring techniques. In either case, the user-defined set of external states and associations with particular

display indications are represented as display configuration data and made available to a monitoring process or service 320.

[1027] In some implementations, user interactions to specify a set of monitored external states and associated display indications are mediated through a networked client computer acting as a user interface (e.g., using browser technology) to configuration data 321 and monitoring process or service 320. In some implementations, user interactions are via (343) the portable device itself. For example, using a simple browser or browser-like facility provided by a portable phone or PDA, the user may specify the monitored external states and associated display indications.

[1028] Given a user-specified display configuration, monitoring process or service 320 performs a query, lookup, database access or other retrieval or information-gathering step (323) to ascertain each monitored state (e.g., from local or remote information sources 330). Retrieved external state information is stored (322) for transmission of a display update. As described above, suitable data encodings for transmission are particular to the telecommunications facilities and space-constrained display device employed (e.g., display 341 of portable phone 340). In general, updates can be pushed to portable phone 340 or supplied in response to a request (e.g., 342). In some realizations, updates are periodically supplied. In some realizations, updates are supplied on detection of a change in a monitored state.

[1029] In general, implementations such as described herein allow monitoring and access of a large amount of data on a constrained display device. Usability problems associated with traditional systems that split data access and navigation over paged small screens are avoided. In addition, overall data density is generally improved. In many realizations, the result is easier access to more data. Notably, encodings of display indications such as described herein can be quite space-efficient. In particular, data encodings of such display indications may be encoded in a few bytes if necessary or desirable. Consequently, the described techniques can facilitate display updates over even low bandwidth networks.

[1030] In contrast with existing text-based linking techniques, which in most practical cases could support no more than 4 links on a screen, some implementations support a

dense grid of display indications which could easily support 20 to 50 links in the same space. Such a data grid can be interpreted quickly since it takes advantage the human perceptual ability to process visual aggregations. Realizations that emphasize such aggregations will tend to group display indications for related events. Some realizations may encourage or enforce such aggregations by predefining (e.g., using display templates) certain portions of a display for display indications corresponding to like events. For example, portions of the display may be preallocated to eMail indications, to weather/environmental indications, to financial indications and/or sport- or family-related indications. Such realizations tend to encourage advantageous visual aggregations while still allowing user selection of a preallocation scheme and/or of particular events and display indications within a preallocated display portion.

[1031] It should be noted that even though the grid can be interpreted visually, the actually grid elements can be made using characters instead of graphics, making the amount of data needed to process and/or store the state of the display minimal. For example, the state information for a 32-cell data grid could be stored in just 4 bytes (compare this to 2KB for even the smallest web graphics, or about 64 bytes for text). Consequently, the described techniques may continue to work well, even under extremely bandwidth constrained situations.

[1032] While the invention has been described with reference to various embodiments, it will be understood that these embodiments are illustrative and that the scope of the invention is not limited to them. Many variations, modifications, additions, and improvements are possible. Plural instances may be provided for components described herein as a single instance. Boundaries between various components, operations and data stores are somewhat arbitrary, and particular operations are illustrated in the context of specific illustrative configurations. Other allocations of functionality are envisioned and may fall within the scope of claims that follow. Structures and functionality presented as discrete components in the exemplary configurations may be implemented as a combined structure or component. These and other variations, modifications, additions, and improvements may fall within the scope of the invention as defined in the claims that follow.